To the National Aeronautics and Space Administration
Review of U.S. Human Spaceflight Plans Committee.

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Requirements for Manned Space Flights to Mars: Should NASA Skip Returning to the Moon?

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In this set of comments, I discuss the additional factors that are required for a successful manned spaceflight to the planet Mars and the decision to return to the Moon first.

A Much Larger Vehicle

A manned spaceflight to Mars would require a much larger vehicle than a manned flight to the Moon. This requirement exists because of the following factors:

1. Greater energy requirement per pound of payload compared to a lunar flight.
2. Psychological need for a much larger crew habitat for the long voyage of over two years [Think ship, not capsule.]
3. Physical need for more supplies and consumables for the long voyage
4. Need for extensive shielding and protections against intense solar radiation events. [Some of the supplies and/or fuel can be used for shielding purposes as well.]
5. Additional needs for redundant and repairable systems and repair tools.
6. Large solar array and/or nuclear power reactor for on board electrical power

7. Possible use of on-board agricultural system for recycling air, water, and food
8. Larger rocket vehicle for Mars surface access compared to the Lunar module

All of these requirements lead to a Mars vessel that is more like a traveling space station than it would be like the small Apollo vehicle (Service Module, Command Module, and Lunar Module).

The Need for a Heavy-Lift Vehicle

This requirement for a larger manned vehicle means that the United States must have access to a big heavy lift rocket if it is to send astronauts on a successful manned mission to Mars or other distant destinations in the solar system. If the USA does not have access to a heavy lift rocket such as the Ares 5, manned flight to Mars is probably impractical.

However, the USA does not necessarily have to design, own, or build such a rocket. It could in theory purchase such rockets from other nations.

The only other option would be to launch a number of smaller rockets with components of the manned Mars craft and assemble all these components in low Earth orbit. This would be a long process like building a space station, and would probably be more costly and difficult than using a large heavy-lift rocket.

The Need for Advanced Propulsion Systems

Sending a large manned vehicle from Earth orbit to Mars requires a lot of chemical rocket fuel. This has been pointed out in engineering studies dating back to Dr. Werner Von Braun's work in the 1950s. This requirement suggests that a more energetic alternative to conventional chemical rockets should be used to propel the Mars craft from Earth orbit to Mars.

One option is to use an ion rocket to provide long-duration thrust. This approach has been used successfully by NASA for the propulsion of an unmanned probe. This technology

reduces the amount of fuel that must be carried on board. It requires a fairly plentiful supply of on board electric power. This trade-off is probably worthwhile, and the ion rocket could potentially shorten the trip time to reach Mars.

Nuclear thermal propulsion is appealing, but it has huge political problems that would be difficult to overcome. Solar sailing is too underdeveloped for application to a large manned vehicle. A similar negative situation applies to any nuclear pulse engine.

Additional propulsion work is needed for manned flights to Mars.

Going to Mars via the Moon

NASA's decision to go to the Moon first and then to Mars makes a lot of sense. Any manned trip to Mars is far more difficult, complex, and expensive than a trip to the Moon. Long duration work on the Moon will help NASA develop the reliable technologies that then can be applied to the long exploration voyages to Mars.

In addition, the Moon provides a good environment for specific technical activities such as:

1. Aggressive biotechnology research that is safely isolated from the Earth's biosphere
2. Development and utilization of natural vacuum electronics that would include very large scale electronic components and circuits for high-power operations (such a megawatt radio frequency oscillators using thermionic valves)
3. Advanced optical and radio astronomy research efforts including very large instruments that are not practical on Earth (including radio astronomy on the far side of the Moon)
4. Mass-driver launches of deep space probes and cargo shipments.

The astronaut who recently said that the Moon is a boring place is wrong. The Moon is a fine place for many advanced scientific and industrial enterprises.

My Background

I am an individual independent inventor holding three U.S. Patents. My latest patent is a wireless bus for computers and other digital devices (U.S. Patent # 6,771,935). I am also a certified electronics technician (ISCET and iNARTE) and an Extra Class amateur radio operator (call sign N3NL). I have a Master of Arts degree in Political Science from the Johns Hopkins University (June 1970). In addition, I am a technical writer. I am a licensed pilot of single-engine airplanes, gliders, and hot-air balloons. I have filed formal comments in numerous Federal technology rule making proceedings.